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Multiscaling at Point J: Jamming is a Critical Phenomenon

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We analyze the jamming transition that occurs as a function of increasing packing density in a disordered two-dimensional assembly of disks at zero temperature for "Point J" of the recently proposed jamming phase diagram. Using numerical simulations, we drag a single disk through an increasingly dense assembly of hard disks. We measure the total number of moving disks and the transverse length of the moving region, and find a power law divergence as the packing density increases toward a critical jamming density. This provides evidence that the zero-temperature jamming transition as a function of packing density is a second order phase transition. Additionally, we find evidence for multiscaling, indicating the importance of long tails in the velocity fluctuations of the driven particle. [1] J.A. Drocco, M.B. Hastings, C.J. Olson Reichhardt, and C. Reichhardt, cond-mat/0310291.